CLAIMS

1. (currently amended) A head-related transfer function (HRTF) model for use with 3D sound applications, comprising:

a plurality of Eigen filters;

a plurality of sets of spatial characteristic function[[s]] (SCF) samples derived from ~~head-related transfer functions~~ one or more HRTFs and adaptively combined with said plurality of Eigen filters; and

a plurality of regularizing models, each regularizing model adapted to ~~respectively~~ regularize ~~said plurality~~ a different set of ~~spatial characteristic functions~~ the SCF samples based on a different smoothness factor prior to said respective combination with said plurality of Eigen filters to provide a plurality of head related transfer functions with ~~varying~~ controllable degrees of smoothness, wherein each different smoothness factor trades off between smoothness and localization for the corresponding set of SCF samples.

2. (previously presented) The head-related transfer function model for use with 3D sound applications according to claim 1, further comprising:

a summer operably coupled to said plurality of combined Eigen filters combined with said plurality of regularized spatial characteristic functions to provide said head-related transfer function model.

3. (previously presented) The head-related transfer function model for use with 3D sound applications according to claim 1, wherein:

said plurality of regularizing models are each adapted to perform a generalized spline model.

4. (previously presented) The head-related transfer function model for use with 3D sound applications according to claim 1, further comprising:

a smoothness control operably coupled with said plurality of regularizing models to allow control of a trade-off between localization and smoothness of said head-related transfer function.

5. (currently amended) A head-related impulse response (HRIR) model for use with 3D sound applications, comprising:

a plurality of Eigen filters;

a plurality of sets of spatial characteristic function[[s]] (SCF) samples derived from ~~head-related impulse responses~~ one or more HRIRs and adapted to be respectively combined with said plurality of Eigen filters;

a plurality of regularizing models, each regularizing model adapted to ~~respectively~~ regularize ~~said plurality~~ a different set of ~~spatial characteristic functions~~ the SCF samples based on a different smoothness factor prior to said respective combination with said plurality of Eigen filters, wherein each different smoothness factor trades off between smoothness and localization for the corresponding set of SCF samples; and

a single regularized head-related transfer function filter produced by summing said Eigen filters and said regularized ~~spatial characteristic functions~~ SCF samples.

6. (previously presented) The head-related impulse response model for use with 3D sound applications according to claim 5, further comprising:

a summer adapted to sum said plurality of combined Eigen filters combined with said plurality of regularized spatial characteristic functions to provide said head-related impulse response model.

7. (previously presented) The head-related impulse response model for use with 3D sound applications according to claim 5, wherein:

said plurality of regularizing models are each adapted to perform a generalized spline model.

8. (previously presented) The head-related transfer function model for use with 3D sound applications according to claim 5, further comprising:

a smoothness control in communication with said plurality of regularizing models to allow control of a trade-off between localization and smoothness of said head-related transfer function.

9. (currently amended) A method of determining spatial characteristic function (SCF) sample sets for use in a head-related transfer function model, comprising:

constructing a covariance data matrix of a plurality of measured head-related transfer functions;

performing an Eigen decomposition of said covariance data matrix to provide a plurality of Eigen vectors;

determining at least one principal Eigen vector from said plurality of Eigen vectors;

projecting said measured head-related transfer functions back to said at least one principal Eigen vector to create said spatial characteristic sets; and

respectively regularizing ~~said spatial characteristic sets~~ each different set of the SCF samples by a ~~plurality of~~ corresponding regularizing model[[s]] based on a different smoothness factor prior to being combined with a plurality of Eigen filters to provide a plurality of regularized head-related transfer functions with ~~varying~~ controllable degrees of smoothness, wherein each different smoothness factor trades off between smoothness and localization for the corresponding set of SCF samples.

10. (currently amended) A method of determining spatial characteristic function (SCF) sample sets for use in a head-related impulse response model, comprising:

constructing a covariance data matrix of a plurality of measured head-related impulse responses;

performing an Eigen decomposition of said time domain covariance data matrix to provide a plurality of Eigen vectors;

determining at least one principal Eigen vector from said plurality of Eigen vectors;

back-projecting said measured head-related impulse responses to said at least one principal Eigen vector to create said spatial characteristic sets; and

respectively regularizing ~~said spatial characteristic sets~~ each different set of the SCF samples by a ~~plurality of~~ corresponding regularizing model[[s]] based on a different smoothness factor prior to being combined with a plurality of Eigen filters to provide a plurality of regularized head-related impulse responses with ~~varying~~ controllable degrees of smoothness, wherein each different smoothness factor trades off between smoothness and localization for the corresponding set of SCF samples.

11. (currently amended) Apparatus for determining spatial characteristic function (SCF) sample sets for use in a head-related transfer function model, comprising:

means for constructing a covariance data matrix of a plurality of measured head-related transfer functions;

means for performing an Eigen decomposition of said covariance data matrix to provide a plurality of Eigen vectors;

means for determining at least one principal Eigen vector from said plurality of Eigen vectors; and

means for back-projecting said measured head-related transfer functions to said at least one principal Eigen vector to create said spatial characteristic sets; and

means for respectively regularizing ~~said spatial characteristic sets~~ each different set of the SCF samples by a ~~plurality of~~ corresponding regularizing model[[s]] based on a different smoothness factor prior to being combined with a plurality of Eigen filters to provide a plurality of regularized HRTFs with ~~varying~~ controllable degrees of smoothness, wherein each different smoothness factor trades off between smoothness and localization for the corresponding set of SCF samples.

12. (currently amended) Apparatus for determining spatial characteristic function (SCF) sample sets for use in a head-related impulse response model, comprising:

means for constructing a covariance data matrix of a plurality of measured head-related impulse responses;

means for performing an Eigen decomposition of said time domain covariance data matrix to provide a plurality of Eigen vectors;

means for determining at least one principal Eigen vector from said plurality of Eigen vectors;

means for back-projecting said measured head-related impulse responses to said at least one principal Eigen vector to create said spatial characteristic sets; and

means for respectively regularizing ~~said spatial characteristic sets~~ each different set of the SCF samples by a ~~plurality of~~ corresponding regularizing model[[s]] based on a different smoothness factor prior to being combined with a plurality of Eigen filters to provide a plurality of regularized head-related impulse responses with ~~varying~~ controllable degrees of smoothness, wherein each different smoothness factor trades off between smoothness and localization for the corresponding set of SCF samples.